Table of Contents

[Summary 2](#_Toc22652610)

[Work performed 2](#_Toc22652611)

[Performance Data 3](#_Toc22652612)

[Survey 3](#_Toc22652613)

[Detector Performance 3](#_Toc22652614)

[Signature 3](#_Toc22652615)

[Dark Signal 4](#_Toc22652616)

[Signal to Background 4](#_Toc22652617)

[Gold Performance 5](#_Toc22652618)

[Appendix – Electronics Documentation 8](#_Toc22652619)

[9600 X-Ray Controller 8](#_Toc22652620)

[V1 calibration results 9](#_Toc22652621)

# Summary

**Visit duration** Tuesday October 15, 2019 – Wednesday October 16, 2019

Time on site: 13 hrs.

# Work performed

* Carried out 6 month preventative maintenance schedule
  + Reviewed state of vacuum system:
    - All valves operating correctly
    - Analyzer base pressure at 1.5e-9 Torr
    - Load lock base pressure at 1.3e-9 Torr
    - Cryo pump He operating pressure ~ 75 psig
    - Both cryo cold heads temp metering <15K
    - Oil added to mechanical pump, was low
  + Replace ion exchange filter and particle filter on Hawk water circulator
  + Checked for leaks and topped off water level in circulator
  + Replaced xray anode
  + Checked all spot sizes and power output
  + Visually inspected lens screens
  + Checked all interlocks
  + Optimized detector voltage for optimum count rate
  + Captured and loaded new signature file
  + Tested detector dark signal without HV for noise
  + Tested fermi edge level for xray window
  + Calibrated V1 slope and offset
  + Calibrated detector width
  + Tested performance of instrument with gold against SPI standards
* Checked operation of ion gauges
* Aligned sputter gun spot with xray analysis spot
* Replaced pump and motor on Hawk water circulator
  + Flow rate improved from 1.24 to 1.45 GPH
* Checked all motor driver settings
  + Current settings are working with motors even though current is higher than normal
* Set screw on rotational axis gear extremely loose, causing bouncing and stage to get stuck occasionally
  + Vented system and tightened set screw, tested rotation before pumping back down

# Performance Data

## Survey



Figure 1 - Survey on gold sample after calibration

Survey recipe:

Spot 800

Res4

1 ev/st

100 ms/step

## Detector Performance

### Signature



Figure 2 - Detector signature capture in unscanned mode, Res4, 600 micron spot, 90 seconds of acquisition

### Dark Signal



Figure 3 - Detector dark signal; captured in unscanned mode, Res4, HV powered off, 60 seconds of acquisition

## Signal to Background



Figure 4 - Fermi edge level data taken with 600 micron spot, Res 4, 60 seconds of acquisition

Signal to Background calculation:

|  |  |  |
| --- | --- | --- |
|  |  | Actual Measurement |
| Peak Valence Band Counts | | 13908 |
| Average Background Counts | | 57.7 |
| Ratio Peak/Background | | 241.0398614 |

\*A ratio of greater than 200:1 signifies an intact xray window

## Gold Performance

Gold Diagonal:



Figure 5 - Performance test on gold; taken with 800 micron spot, Res 4, 60 seconds unscanned acquisition

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Peak ID | Adj'ed Be | Area | FWHM | % Gauss |
| Au4f7 | 83.912 | 1517986 | 1.634 | 86.803 |
| Au4f5 | 87.58 | 1227854 | 1.682 | 84.233 |



Figure 6- Performance test on gold; taken with 600 micron spot, Res 3, 60 seconds unscanned acquisition

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Peak ID | Adj'ed Be | Area | FWHM | % Gauss |
| Au4f7 | 83.952 | 1122483 | 1.273 | 85.37 |
| Au4f5 | 87.597 | 883139 | 1.253 | 84.132 |



Figure 7 - Performance test on gold; taken using 300 micron spot, Res2, 60 seconds of unscanned acquisition

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Peak ID | Adj'ed Be | Area | FWHM | % Gauss |
| Au4f7 | 83.884 | 491568 | 0.903 | 75.196 |



Figure 8 - Performance test on gold; taken with 150 micron spot, Res1, 60 seconds of unscanned acquisition

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Peak ID | Adj'ed Be | Area | FWHM | % Gauss |
| Au4f7 | 83.909 | 63664 | 0.755 | 100 |

Gold Diagonal performance:

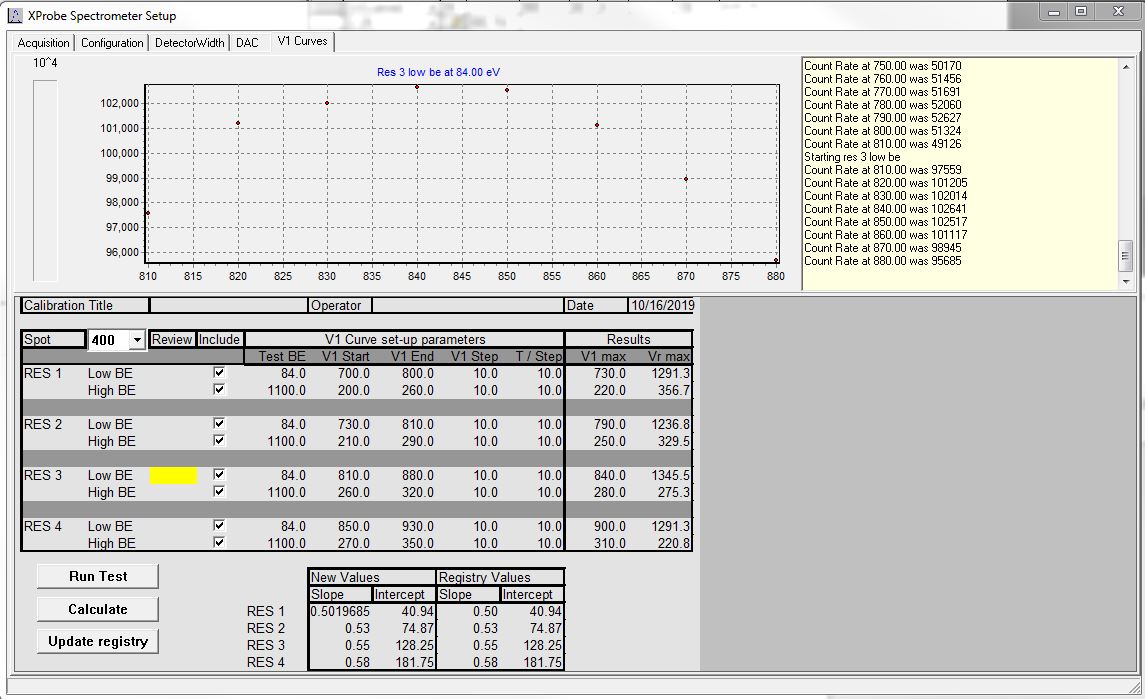
|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Unscanned Performance** | | | | | | | | |
|  | BE - 84 eV | 1 minute acquisition | |  |  |  |  |  |
| RESOLUTION | SPOT SIZE | | | | | | | |
|  | 150 micron | | 300 micron | | 600 micron | | 800 micron |  |
|  | SPEC | ACT | SPEC | ACT | SPEC | ACT | SPEC | ACT |
| RES 1 - 25eV |  |  |  |  |  |  |  |  |
| RESOLUTION | 0.75 | 0.75 | 0.77 |  | 0.90 |  | 1.00 |  |
| AREA - K CNT | 30.00 | 63.00 | 120.00 |  | 180.00 |  | 250.00 |  |
| RES 2 - 50eV |  |  |  |  |  |  |  |  |
| RESOLUTION | 0.85 |  | 0.90 | 0.90 | 1.05 |  | 1.10 |  |
| AREA - K CNT | 50.00 |  | 200.00 | 491.00 | 280.00 |  | 480.00 |  |
| RES 3 - 100eV |  |  |  |  |  |  |  |  |
| RESOLUTION | 1.20 |  | 1.25 |  | 1.40 | 1.27 | 1.38 |  |
| AREA - K CNT | 70.00 |  | 280.00 |  | 410.00 | 1122.00 | 600.00 |  |
| RES 4 - 150eV |  |  |  |  |  |  |  |  |
| RESOLUTION | 1.42 |  | 1.45 |  | 1.70 |  | 1.65 | 1.64 |
| AREA - K CNT | 80.00 |  | 320.00 |  | 470.00 |  | 700.00 | 1517.00 |

# Appendix – Electronics Documentation

## 9600 X-Ray Controller

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Service Physics Model 9603 X-Ray System** | | | | |  |  |
|  | **PARAMETER TABLES** | | | | |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| COMPANY | Cal Tech MMRC | |  |  |  |  |  |
| CUSTOMER | Bruce B. |  |  |  |  |  |  |
| DATE | 10/15/2019 |  | COMMENT: |  |  |  |  |
| TEST ENGINEER | Zach Mehl |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| Gun Info |  | |  |  |  |  |  |
| S/N | N/A | |  |  |  |  |  |
| Date Installed | N/A - pre 2017 | |  |  |  |  |  |
| Notes | Extra thick copper gasket | |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  | **SPOT SIZES** | | | | |  |  |
|  | 100 | 200 | 400 | 800 | L1 | L2 | L3 |
| I Out | 1.48 | 4.99 | 9.94 | 19.9 | 4.99 | 9.94 | 19.9 |
| I Fil | 1.12 | 1.13 | 1.14 | 1.15 | 1.13 | 1.14 | 1.14 |
| V 2KV | 2.31 | 2.31 | 2.31 | 2.31 | 2.31 | 2.31 | 2.31 |
| I 2KV | 6.27 | 6.95 | 7.43 | 7.95 | 6.92 | 7.4 | 7.93 |
| VQ | 0.01 | 0.02 | 0.01 | 0.02 | 0.01 | 0.38 | 0.32 |
| VF | 8.42 | 8.48 | 8.43 | 8.56 | 8.4 | 8.41 | 8.63 |

## V1 calibration results

****